IN THE SPECIFICATION:

Please amend the following paragraphs as indicated. The paragraph numbering used below is from the application as published, since the originally filed application did not number its paragraphs.

[0004] The essential requirements of typical fuel cells (see, e.g., FIG. 1) include: first, the fuel cell requires efficient delivery of fuel and air to the electrode, which typically requires complicated microchannels and plumbing structures. A second requirement is that the fuel cell should provide easy access to the catalyst and a large surface area for reaction. This second requirement can be satisfied by using an electrode made of an electrically conductive porous substrate that renders the electrode permeable to fluid reactants and products in the fuel cell. To increase the surface area for reaction, the catalyst can also be filled into or deposited onto a porous substrate. However, these modifications result in a fragile porous electrode that may need additional mechanical support, such as by use of a fiber matrix. Alternatively, the electrode can be made of an etched porous Vycor glass substrate or an etched-nuclear-particle-track membrane substrate to improve its toughness and strength. A third requirement is close contact between the electrode, the catalyst, and the PEM. The interface between the electrode and PEM is a discontinuity area as concerns the electric current transmission wherein the charge carriers are the electrons, on one side, and the protons on the other side. A solution to this problem has been attempted by hot pressing of the electrodes onto the PEM (U.S. Pat. No. 3,134,697). Another solution suggests the intimate contact of the catalytic particles with a protonic conductor before interfacing the electrode with the electrolyte (U.S. Pat. No. 4,876,115). Other solutions are described in U.S. Pat. Nos. 5,482,792 and 6,022,634. A fourth requirement is that the fuel cell should provide

for humidity control of the electrode. The PEM requires water to be effective in conducting ~~proton~~ protons. However, since it operates at a higher temperature than its surroundings, the PEM tends to dehydrate during operation. The typical method of re-hydrating the PEM is to capture water in the exhaust stream and circulate it back to the PEM.

[0008] The flex based fuel cell can confine water between the two flex substrates to provide moisture for the PEM. Since deionized water can easily conduct protons, but not electrons, a fuel cell can be constructed without the PEM. Two flex substrates without the PEM layer can be bonded together face-to-face with an adhesive layer in between as ridges.

[0025] FIG. 2 is a simplified cross-section view showing an exemplary flex based fuel cell 100. The fuel cell 100 includes a right flex circuit A and a left flex circuit B. This naming convention is purely arbitrary and is used to add greater clarity to the description of the flex based fuel cell 100. Two flex substrates 101 and 102 are assembled face-to-face together with a PEM 103 in between. On either side of the PEM 103 are porous material and catalyst layers 104. Adjacent to the PEM 103 is a palladium (Pd) layer 105 that prevents cross-over of the methanol fuel. Adjacent to the porous material and catalyst layers 104 are anode and cathode electrodes (conductors) 106 and 107. A dry film adhesive 108 serves to separate portions of the fuel cell 100. Recycled water 109 flows through the fuel cell 100, as shown. A liquid fuel 110, such as methanol, for example, is provided on the anode side of the fuel cell 100. Air and water vapor 111 flow past the cathode electrode 107. The methanol fuel 110 has direct contact with the porous material layers 104 through openings 112 in flex substrates 101, 102. The methanol fuel 110 is delivered by the porous material layers 104 to an active catalytic surface 105 where CH_3OH reacts with H_2O (methanol) to form CO_2 and protons. The protons

then diffuse through the PEM layer 103 and reach ~~a catalytic layer~~ the cathode 107, where the protons combine with oxygen to form H_2O. The left flex circuit B of the fuel cell 100 is open to the atmosphere, which serves to supply the oxygen to the fuel cell, and carry away the reactant water vapor 111.

[0030] Thus, by careful design, the liquid fuel (methanol) 110 can be ~~mode~~ made to supply all portions of the fuel cell 100 without elaborate pumps and plumbing. Note that pores in the porous metal layer 104 may be oriented in the local plane, or substantially in the local plane defined by the flexible substrates 101, 102. The pores may be further oriented such that liquid fuel will be transported in a specified direction (e.g. vertically) within the porous metal layer 104 so that liquid fuel reaches all, or substantially all, of the fuel side flex circuit A (see FIG. 2).

[0032] As shown in FIG. 4, a flex fuel cell assembly 130 can be shaped into the form of a cylinder. An interior 131 of the cylinder would be the fuel side, and an exterior 132 of the cylinder would be the oxygen side. The fuel cell can be sealed at a top 133 and a bottom 134 of the cylinder interior 131 to provide a container for the liquid fuel. Alternatively, the cylinder top may be left unsealed. In an additional embodiment, liquid fuel may be supplied to the exterior 132 of the flex fuel cell assembly 130.

[0034] Because the flex fuel cell assembly 130 can be molded to a variety of shapes, the flex fuel cell assembly 130 is ideal for power applications that are constrained in size and shape. Thus, a fuel cell system using the flex fuel cell assembly 130 can be shaped to fit virtually any

container or enclosure, allowing the fuel cell system to be used in a wide variety of applications where prior art fuel cell systems would not be useable.

[0040] The final step, as shown in FIG. 5E (plan and side views), is to cover the surface of the catalytic layer 153 with a thin layer of PEM ~~155~~ 159. In a preferred embodiment, the flex structure is dipped into a 5% Nafion solution. A thickness of the PEM ~~155~~ 159 should also be controlled so that the liquid fuel can diffuse through this thin layer.

[0044] In a departure from other fuel cell designs, the flex circuit 200 does not use a PEM. Instead, a thin layer 209 of ~~dionized~~ de-ionized water is maintained between the porous metal and catalyst layers 204. By maintaining a spacing between the porous metal and catalyst layers 204, the flex circuit 200 is able to generate protons from the liquid fuel 210 and the protons are combined with oxygen to form water. That is, the ~~dionized~~ de-ionized water conducts protons but does not conduct electrons. Thus, by eliminating the PEM, the flex circuit 200 shown in FIG. 6 is less costly to build.